zeta coefficient laboratory in CFD

Specification

1. CFD software and settings
   1. Software: OpenFoam (BlueCFD), Ladybug Tools, Butterfly 0.0.5
   2. flow regime models
      1. Pick the one from the article Karsten Tawackolian, Martin Kriegel, *Turbulence model performance for ventilation components pressure losses*
   3. schemes
      1. higher order QUICK
   4. Unstructured Mesh. 3D body-fitted coordinate (bfc) grid system to ensure that the curved walls of duct fittings are accurately modelled. DO NOT USE RECTANGULAR CARTESIAN GRID.
2. Source of fittings geometry
   1. rfa libraries
   2. manufacturer catalogs
3. Streamlined process for defining inputs, running simulation, retrieving results and post processing outputs.
4. Tests and validation
   1. Sensitivity Analysis. The convection is that the dzeta values should be velocity or Reyndolds independent. “However, it is known that a Reynolds number dependency exists for bends especially in the range Re < 2×10^5 (Koch 2006; Idelchick 2008).”
   2. The duct fragment before the fitting and after the fitting should be long enough. Check if the velocity profile is fully developed. The Pa/m in the straight duct should be constant at some point. Shorten or extend the fragments if needed.
   3. Check wide range of duct sizes and see how relative boundary air film can affect the results
   4. Increase grid size until there is no significant difference in the results
5. Local pressure loss equation:

Dzeta equation – calculation formula:

Boundary condition inputs defined:   
ρ = 1.2 kg/m3  
v = 6 m/s

Output from CFD:   
1. ∆p - pressure difference before the fitting and after the fitting  
2. ∆p – pressure loss difference between the setup with fitting and without fitting

With the above boundary condition inputs, CFD output, and this formula I should be able to calculate the dzeta.

1. Notes:
   1. Increase density locally within the fitting while maintaining the existing grid resolution in the straight ducts. This should significantly enhance accuracy without compromising simulation time
   2. Based on 1995 paper “the accuracy of CFD and its maximisation should be examined on a fitting-by-fitting basis.”
   3. Finding the model that works well with all flow conditions laminar, transition and turbulent is the holy grail.
   4. The greatest accomplishment would be to generalise the procedures to create an accurate laboratory for all fittings and all flow conditions.

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A screenshot of a computer

Description automatically generated

Bibliography:

Karsten Tawackolian, Martin Kriegel, *Turbulence model performance for ventilation components pressure losses*